

eXecute-In-Place

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MS-DOS computers typically execute programs from system RAM space. Often, these programs are loaded from magnetic-based, serial-transfer, I/O media like floppy or hard disks, or sometimes tape drives. Since memory cards are computer-readable random-access devices, programs stored in cards can be executed directly by the processor when the appropriate mapping methods are employed (see figure 1). An eXecute-In-Place (XIP) working

group within the Personal Computer Memory Card Industry Association (PCMCIA) technical committee developed some basic concepts and a list of requirements that lay the implementation groundwork. Two basic goals are:

- Low-Cost XIP Hardware
- "Lowest Common Denominator" Compatibility Approach

Although laptop, notebook, and palmtop systems have a great deal of latitude supplying memory space for XIP within the regions of the first

megabyte of memory, desktop systems do not. Typical ISA, EISA, and MCA systems have many constraints that complicate freeing regions larger than 64Kbytes for XIP. Therefore, XIP should be defined to work in the "lowest common denominator" configuration. If a system can supply extra memory regions for XIP beyond the "lowest common denominator" configuration then that is optional. This enables XIP applications to run on either a desktop or a laptop. The minimal 64Kbyte XIP configuration minimizes system costs with its low complexity and by supporting 1Mbyte-constrained systems. In order to meet these goals, the XIP requirements were defined as follows:

Requirement 1

A system supporting XIP must be able to allow the mapping of an XIP memory block on a 16Kbyte boundary of system address space. Typically, these 16Kbyte boundaries will be above the 640Kbyte user-application address range. However, this is not mandated.

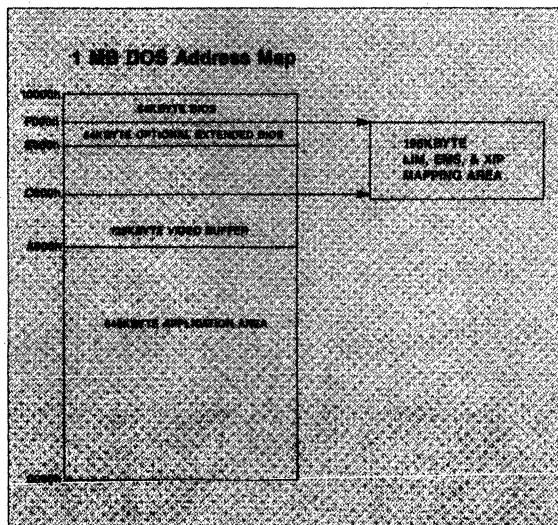


Figure 1.

About the Author

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Requirement 2

A system supporting XIP must be able to simultaneously map a minimum of four 16Kbyte pages into the system address space.

Requirement 3

A system supporting XIP mapping must be able to map the minimum of four 16Kbyte pages contiguously. Taken together, requirements 1 through 3 imply that the system be able to support mapping of four 16Kbyte pages into a 64Kbyte page frame. This minimum page frame must be able to start on a 16Kbyte boundary within the processor address space.

This requirement exactly matches a minimal Lotus-Intel-Microsoft (LIM) implementation usually referred to as the LIM 3.2 page frame.

Requirement 4

XIP memory mapping hardware will view the 64Mbyte physical address space of PCMCIA PC memory card as 4096 regions that are each 16Kbytes long. Each 16Kbyte region is called a "page." Obviously, every page starts on a 16Kbyte boundary (See figure 2, XIP Memory Card Address Map).

A minimal XIP mapping hardware implementation must be able to map any four of the 4096 pages in the PC memory cards partition into the processor's address space.

Requirement 5

Since a PC memory card can be "partitioned" into several file systems and an XIP partition, the previous requirements have a side effect on the physical location of an XIP partition within a card. An XIP partition within a PCMCIA compliant card must start and end on a 16Kbyte physical address boundary within the card. Only one XIP partition is allowed per memory card.

For cards that have individual, chip-erasable devices, like Intel's 1Mbyte and 4Mbyte flash memory cards, an XIP partition should not overlap devices that contain another partition. Instead, the XIP

partition should start on an unwritten device. This prevents an erasure of one partition destroying data in another partition. If the XIP partition ends without filling up a chip-erasable device, the whole device is still considered part of the XIP partition.

The granularity of the XIP pages, the processor address boundaries where the pages can be mapped, and the page's physical address boundaries within the PC memory card simplify the design of the mapping hardware.

Requirement 6

XIP must be compatible with LIM 4.0. That is to say, the presence of

the XIP driver and XIP applications in a system must not "break" either the LIM 4.0 driver or applications that depend on LIM 4.0.

Summary

The XIP specification made tremendous progress over the past year as evidenced by the clean, complete-draft showing at the March PCMCIA meeting. There is good consensus between Japanese Electronics Industry Development Association (JEIDA) and PCMCIA on the XIP specification. Only minor changes need to be made to the final draft for inclusion in the May pre-release of PCMCIA Release 2.0 specification. □

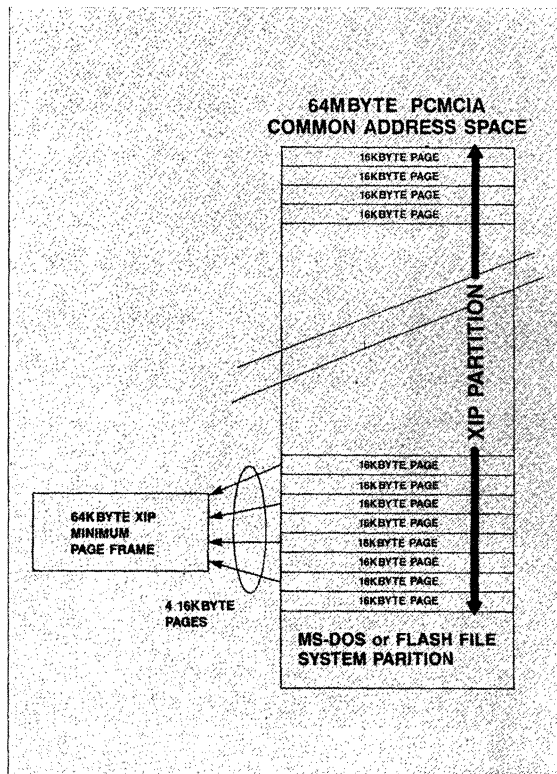


Figure 2.